354
50/3
Davis and Reymers

IMPROVEMENTS IN NAVIGATION, AND PHILOSOPHY.

Which contains,

I. An eaſy Method of finding the LONGITUDE at Sea, which will be eaſily practicable there, and which will determine the ſaid LONGITUDE within ten or fifteen Minutes at moſt: Alſo a more eaſy Method of finding the LATITUDE, and that by the ſame Inſtrument that finds the LONGITUDE, and to the ſame Pitch of Exactneſs, and without any Regard to the Sun's Shining, or the Sun's Declination, or any Calculation; but if the Horizon be clear, Sailers may ſee the true Number of the Degrees and Minutes of both the LONGITUDE and LATITUDE of the Place they are in, upon the Inſtrument before their Eyes.

II. In the next Place, here is an Endeavour, to amend ſome Things, in the preſent Account of the Syſtem, and the principal Phænomena of this viſible World; containing great Improvements in PHILOSOPHY.

Omnia diligentia ſubjiciuntur.	ANTIPHAN.
Dura tamen molli ſaxa cavantur aquâ.	OVID.
Omnia conando docilis ſolertia vincit.	MANIL. I.

By WILLIAM COMINE, *A. M.*
Vicar of Whiſſendine *in* Rutland.

LONDON:
Printed for the AUTHOR; and Sold by T. ASTLEY, at the
Roſe in *St. Paul's Church-Yard.* MDCCXXXIX.

1739

PATENT OFFICE
LIBRARY.

BRITISH MUSEUM
18 70
MAR

TO THE

RIGHT HONOURABLE

RIGHT WORSHIPFUL

PATENT OFFICE LIBRARY

COMMISSIONERS,

Appointed by Act of Parliament for the Diſcovery of the Longitude at Sea.

Right Honourable and Right Worſhipful,

HERE I humbly offer to your learned and judicious Conſideration, the Improvements mentioned in the Title-Page; and firſt, here is an eaſy Method of finding the Longitude at Sea, by a Mathematical Inſtrument of ſmall Charge, and eaſily made, being only a Quadrant of a Circle of 18 Inches Radius, all in one Arch, the Degrees and Minutes cut out on both Sides, with its Sight, and Horizon Vanes; and a Pedeſtal for it to reſt on, for the ſhort Time of making Obſervation; and ſince Obſervation may be made with ſuch an Inſtrument, at any Time when the Horizon is clear, and the Sea ſo calm as not to make the Ship to toſs or tumble, therefore this Method muſt be eaſily practicable at Sea; and it will determine the Longitude within ten or fifteen Minutes at moſt, yea and nearer too, if ſome thin Miſts about the Horizon, and Surges on the Face of the Waters, did not hinder. Here is alſo a more eaſy Method of finding the Latitude, by the ſame Inſtrument that finds the Longitude, and to the ſame Pitch of Exactneſs; and that without any Regard to the Sun's Shining, or to the Sun's Declination, and without any Calculation; but if Obſervation be made in due Manner, the Sailers may ſee the true Number of the Degrees and Minutes,

nutes, both of the Longitude and Latitude of the Place they are then in, upon the Inſtrument before their Eyes: And I hope that the Peruſal and thorough Conſideration of what follows, will make the Truth of what is here written, appear ſo feaſible, and ſo very probable to you, the Honourable and Worſhipful Commiſſioners, as that you will judge it neceſſary to order the Inſtruments to be made at the publick Charge, which cannot amount to five Pounds, and then ſtraightway order Trials and Experiments to be made, in ſuch Places of the Channel as you ſhall think fit to appoint; and if the Inſtruments be made, and Obſervations be made with them, according as it is herein after directed, and a true Account of the Succeſs, be returned to the Right Honourable Board of *Admiralty*, I make no Doubt but that the ſame will fully anſwer all my Expectations; and then, and in that Caſe, I hope you will alſo judge it neceſſary, to make farther Trials and Experiments of the Inſtruments, in ſome foreign Voyage, or Voyages, as you ſhall think fit to appoint, that ſo all Perſons concerned may be fully ſatisfied, that my Method is ſo exceeding good, as that it will certainly ſhow the true Number of the Degrees and Minutes, both of the Longitude and Latitude of the Place they are then in, unto all Sailers that ſhall pleaſe to make uſe of the ſame. And theſe Things, I hope, will be allowed to be conſiderable Improvements in Navigation.

And as to Improvements in Philoſophy, I have here endeavoured to make ſome Amendments, as to the Syſtem, and the principal Phænomena of this viſible World; ſuch as the Cauſe of the Tides, perpetual Springs, Trade-Winds, and the Monſoons; and ſeveral other Things that may be uſeful and ſerviceable in the Study of Philoſophy: And this, I hope, will ſerve for a pleaſing Amuſement and Diverſion to the Learned and Judicious, after the Fatigue of a ſtrict and ſevere Examination of the Premiſes that relate to Navigation: From all which Things, I hope it will appear, that I am willing and very deſirous, to be uſeful and ſerviceable to my Country, and that even in ſome of the moſt uſeful, and moſt difficult Enterprizes; and therefore, I humbly expect, that you, the Honourable and Worſhipful Commiſſioners, will not diſmiſs my Performances, with only a tranſient View, or a diffident Inſpection; but will rather endeavour to improve them to the moſt and beſt Uſes they are capable of; and then it is hoped the Succeſs will be ſo exceeding good, as to incline you to honour me with your Approbation, and ſome ſuch Reward, as ye ſhall judge to be reaſonable and ſufficient to encourage the Ingenious hereafter, to ſtudy ſuch Inventions, as may be uſeful and ſerviceable to his Majeſty's Subjects. So, heartily wiſhing, that the Peruſal and Conſideration of what follows, may be as pleaſing and delightful to all judicious Readers, as the deviſing them has been hard and difficult to me, I ſhall only add, that I am deſirous to be,

Right Honourable and Right Worſhipful,

Whiſſendine,
in the County of Rutland,
Novem. 2,
1738.

Your moſt obliged,

And moſt humble Servant,

William Comine.

IMPROVEMENTS
IN
Navigation and Philoſophy.

PATENT OFFICE LIBRARY

Concerning the Improvements of Navigation.

IN this Method or Scheme, for the Diſcovery of the Longitude at Sea, and the more eaſily finding the Latitude, there are two or three Things ſuppoſed, which it is hoped may be allowed and granted, without any Damage or Inconveniency whatſoever, *viz.*

I. It is ſuppoſed, that the Surface of the Waters of the Seas, is circular, or globular, except what Surges or Waves are raiſed by the Winds: For though the Shadow of the Earth ſeems to make it a Spheroid, yet that ſeems to be occaſioned, only by the great Heaps and Hills of Snow, and the high Banks of Ice, which continually remain about the North and

South Poles, for the Space, perhaps, of 10 or 20 Deg. round each Pole; and theſe great Gibboſities or Protuberances of Ice and Snow, make the Shadow of the Earth ſeem to be a Spheroid: But yet under theſe Heaps of Snow and Ice, the Body of the Sea and Land ſeems to be round and circular, from Weſt to Eaſt, and from North to South; which is confirmed by this, that when a Ship appears at Sea, only her Top-Maſts are ſeen firſt, and then all the reſt of her Maſts, as ſhe draws nearer; whereas, if the Surface of the Waters was plain, and on a Level, whenever a Ship appeared at Sea, ſhe would be all ſeen at once: And if the Surface of the Sea be globular and circular, then a Ship, at her Departure, or in the Place from which ſhe ſets ſail, is in the Zenith, as to the Surface of the Waters, and has the Horizon all round her at 90 Deg. Diſtance; but for every three Leagues that the Ship removes from thence, the Horizon is changed, ſo as that it may be perceived by Help of a good Inſtrument; and therefore ſuch an Inſtrument, as will take Notice of the Horizon of the Place, from which the Ship ſets ſail, and ſhow how far it is diſtant from ſome remarkable Place, ſuch as a middle Line, or a prime Meridian; and

BRITISH MUSEUM 18 70 MAR

alſo after the Ship has proceeded in her Voyage, ſome 20 or 30 Leagues, or a greater or leſſer Number, will then alſo take Notice of the Horizon of the Place the Ship is in at preſent, and will ſhow how far it is diſtant from the Horizon of the Place from which ſhe ſet ſail, and alſo will ſhow how far the preſent Horizon is diſtant from a middle Line, or a prime Meridian: Such an Inſtrument, I ſay, cannot chuſe but to be a moſt excellent Means of finding both the Longitude and Latitude at Sea.

A II^{d} Thing ſuppoſed by this Scheme is, That the Meridian of the Weſt Side of the Peak of *Teneriff*, is to be counted and deemed the firſt or prime Meridian, at which there be no Deg. or Min. of Longitude; but that from this Meridian, both Weſtward and Eaſtward, the Deg. of Longitude are to be computed, by 1, 2, 3, &c. unto 90 Deg. and ſo backward from 90 by 89, 88, 87, &c. unto 3, 2, 1. and no Deg. at the ſaid Meridian: So that by this Meridian of *Teneriff*, the Longitude is to be divided into Eaſt Longitude and Weſt Longitude; as by the equinoctial or middle Line, the Latitude is divided into North Latitude and South Latitude.

A III^{d} Thing ſuppoſed in this Scheme is, That every Deg. of Longitude, does contain 60 Min. or Geographical Miles, in all Places of the World: And this ſeems abſolutely neceſſary to be allowed, in order to a true Diſcovery of the Longitude; becauſe hitherto the Sailers were forced to allow ſometimes but 15, ſometimes 20, and ſometimes 30 Min. to a Degree of Longitude, and that in all Places to the Northward, or to the Southward of 30 Deg. of Latitude; not knowing, at the ſame Time, whether theſe Minutes they allowed, were too many, or too few: And this could be nothing but Gueſs-work, and proceeding upon mere Uncertainties, and ſo but little better than throwing Croſs and Pile for their own Lives. But when Sailers ſhall have a firſt, or prime Meridian, fixed and ſettled, from which, and to which, they may compute 90 Degrees of Longitude, and each Degree contains 60 Min. after the ſame Manner as they are wont to compute the Degrees of Latitude, to, and from, the middle Line; then they may know what they are doing, and proceed upon ſure Grounds; which, through the Bleſſing of God, muſt needs tend much to their Preſervation.

Theſe Things being premiſed, which I hope will be as readily allowed, as they are ſuppoſed; I proceed to ſhow, how the Inſtruments are to be made, which are to be uſed in this Scheme; and they are only two, *viz.* a Quadrant of a Circle of 18 Inches Radius, in one Arch; and a Pedeſtal on which the Quadrant is to reſt, during the Time of making Obſervation.

How the Pedeſtal is to be made.

THE Pedeſtal is to be a ſtrong Staff, four Feet long including its Cape; the Foot of the Staff is to conſiſt of two little Boards Inch thick, ſix Inches long, and two Inches broad; the Boards to be tenented into one another at right Angles; in the Middle of them there is to be a Hole, into which the lower End of the Staff is to be fixed faſt; the Body of the Staff may be turned, and handſomely painted, if you pleaſe; but the uppermoſt half Foot of it, is to be two Inches ſquare; in its Top is to be a round Hole above an Inch deep, and near the lower Part of its half Foot ſquare, there are to be two Slits through it, the Slits to be half an Inch broad, and $\frac{1}{8}$ of an Inch wide; the Cape of the Pedeſtal is to be 8 Inches long, and of the like ſquare with the Top of the Staff, ſave that the loweſt Inch of it is to be made round, ſo as it may go into the Hole in the Top of the Staff, and be eaſily turned there; and the uppermoſt Inch of the Cape is to have a Notch made in its Top, which Notch is to be an Inch deep, and half an Inch wide, with a little Hole for a ſmall wooden Pin to paſs through both Sides of the Notch, in which Notch the Middle of the Radius of the Quadrant is to be placed, and there fixed with the Pin, in Time of making Obſervation. Moreover, at one Side of the Staff a little Hole is to be made, into which a Peg may be put, with a Line and Plummet hanging at it, with a little Bow fixed in the Staff, to keep the Plummet from flying out too far; by Help of which Plummet, the Pedeſtal may be made to ſtand perpendicular. And further, there muſt be made a little Board or Shelf, half an Inch thick, and ſix Inches ſquare; and unto it muſt be fixed under one Side of it, two Iron Pins ſtanding out two Inches from the Side, in ſuch Manner, that theſe Pins may be thruſted into the two Slits made before in the upper End of the Staff, when they come to make Obſervation; at which Time the Sailers Compaſs is to be placed upon this Shelf, until the preſent Variation of it is found, in order to know which be the due Eaſt, or Weſt, and the due South, or North Points; according to which the Quadrant muſt be duly placed in the Time of making Obſervation; and ſo this Shelf on the Side of the Pedeſtal may be called the Compaſs Shelf; and thus, and with all the forementioned Parts, the Pedeſtal is carefully to be made.

How the Quadrant is to be made.

THE Quadrant is to be the fourth Part of a Circle of 18 Inches Radius; it muſt be all in one Arch, and one Inch at each End of the Arch more than the fourth Part of the ſaid Circle, that ſo the Sight Vane may reſt upon this Inch, until Obſervation be made up to the 90th, or to no Deg. of the Quadrant: This Arch muſt be ſupported with two Radius's, made faſt in the two Ends of it, to meet and be joined into one another at the Center; and a Piece of Wood muſt be fixed into each of the two Radius's, and into the loweſt Edge of the Quadrant, in ſuch Manner as may beſt keep the ſame from warping; and when the Maker has fixed or marked the Center of one Side of the Quadrant in the extreme Point of the Radius, he muſt take ſpecial Care to place the Center of the other Side of the Quadrant in ſuch Manner, as the two Centers be diametrically oppoſite to one another; and from theſe two Centers he muſt cut out the Deg. and Min. on both the Sides of the Quadrant, in ſuch Manner as was wont to be done on the largeſt Arch of the Latitude Quadrants, and do it with the utmoſt Exactneſs; ſo that every Deg. on one Side, may be juſt oppoſite and over-againſt the ſame Deg. on the other Side; and he muſt begin to cut out, 0, 1, 2, 3 Deg. *&c.* upon one End of the Quadrant on both Sides of it, and ſo all the reſt of the Deg. and Min. in their Order on both Sides, until he come to 90, that ſo the 90th Deg. may be on both Sides in the other End of the Quadrant, leaving the Inch at each End bare, without any Deg. or Min. on it; and a little Hole muſt be made in the Middle of each of the two Radius's, through which a Pin may paſs through the Holes in the Notch of the Cape of the Pedeſtal before-mentioned, to keep the Quadrant ſteady in its due Place, while Obſervation is making: And thus the Body of the Quadrant will be finiſhed, excepting a Place for the Horizon Vane: This Vane is to be made as uſual, except that juſt at the End of the Slit, a round Braſs Pin is to be fixed, a little longer than the Thickneſs of the Radius, with a Screw on the Point of it, and a little, longiſh Braſs Button to be ſcrewed on the Pin; and then to hold this Braſs Pin, if the Radius be long enough, a Hole may be bored or drilled through it, cloſe to the Center on both Sides, through which Hole the Braſs Pin may be thruſt, and ſo buttoned on the back Side; or if the Radius is but little beyond the Center, then a little Braſs Plate may be fixed to the End of the Radius, ſo bent in the Middle, as that the Braſs Pin at the End of the Horizon Vane may paſs between it, and the End of the Radius, cloſe to the Center on both Sides, and there be buttoned as before; and ſo by either of theſe Ways, the Horizon Vane may be kept in its due Place, as it uſed to be on Latitude Quadrants; and yet the Button muſt not be ſcrewed on ſo very faſt, but that the Face of the Horizon Vane may be turned ſo, as to anſwer all the Degrees of the Quadrant;

drant: And no other Vane, beſides the Horizon Vane, will be needful in this Scheme; but only a Sight Vane, which is to be made, in all Reſpects, as the Sight Vanes for the Latitude Quadrants; and by ſome eaſy Spring, made to ſtick on the Arch of the Quadrant, and yet be eaſily moved up, or down, the ſame. And ſo much to ſhow how the Inſtruments, needful in this Scheme, are to be made; and I have given ſuch a particular Account of every Part of them, on Purpoſe that any good Workman, by attending to what is here written, may eaſily make the Inſtruments ſo exactly and truly well, as that they ſhall not fail to do the great Feats, for which they were deviſed, *viz.* to find both the Longitude, and Latitude at Sea, in the Manner following. And firſt, of the Longitude.

Some general Rules to be obſerved, in making Obſervation for Longitude.

I. IN Order to find the Longitude, Obſervation is to be made, only toward the Eaſt Point, or towards the Weſt Point, of the Horizon; which Point is to be known, by finding the Variation of the Compaſs.

II. Obſervation is to be made to the Weſt Point, if you intend to ſail, or are ſailing weſterly; and ſo toward the Eaſt Point, if you intend to ſail, or are ſailing eaſterly: But if the Horizon, towards which you are ſailing, does happen to be hazy, I ſuppoſe that Obſervation may be made to the oppoſite Horizon, if it be clear; of which more afterwards.

III. No Obſervation is to be made towards any Horizon, but what is pretty clear, and the Sea not ſo rough as to make the Ship tumble.

IV. It is convenient that the Ship ſhould lie by, during the ſhort Time of making Obſervation.

Particular Rules in making Obſervation for Longitude.

I. BRING the Inſtruments upon the main Deck of the Ship, and place the Pedeſtal near that Side of the Ship, which lies next to that Horizon, towards which you intend to make Obſervation; then trim the Pedeſtal, by putting on its Cape, and fixing into it the Compaſs Shelf, and the Line and Plummet, in the Places appointed for them, as before-mentioned;

and make the Pedeſtal ſtand perpendicular by Help of the Plummet at its Side, by putting a Knife or a Chip under that End of the Foot which ſeems to be too low.

II. Then place the Mariner's Compaſs upon the Shelf, and find the Variation of it, as it ſtands there, by the Sun's preſent Amplitude, or Azimuth; and mark well at what Degrees of the Compaſs the true Eaſt and Weſt Points do then lie, the Variation allowed.

III. Conſider, whether the Place you are in be to the Eaſtward, or to the Weſtward, of the Meridian of the Peak of *Teneriff*; and whether you be going towards the ſaid Meridian, or going from it: And if you be going towards the ſaid Meridian, whether you be to the Eaſtward, or the Weſtward of it, then be ſure to turn that End of the Quadrant uppermoſt, which has no Deg. or Min. But if you be going from the ſaid Meridian, whether Eaſtward, or Weſtward, then be ſure to turn that End of the Quadrant lowermoſt, which is marked 0, 1, 2, 3, 4. ſo that the End of the Quadrant marked thus, is always to be uppermoſt, when you go towards the prime Meridian, and lowermoſt when you go from it: And having thus turned the Quadrant as it ſhould be turned, put the Vanes on the South Side, when you ſail Weſtward, and on the North Side of the Quadrant, whenever you ſail Eaſtward: And in putting on the Vanes, put the Braſs Pin of the Horizon Vane thro' the Hole at the End of the Radius, cloſe to the Center, with its Face towards the Arch of the Quadrant, and ſcrew on the Button on the Point of the Braſs Pin, to keep the Vane in its Place; yet not ſo faſt but that it may be turned to any Deg. of the Quadrant: And then in placing the Sight Vane, be ſure to put it to that Degree of the Quadrant, which you ſuppoſe, or gueſs the Place you are in, to be diſtant from the Meridian of *Teneriff*; as if you ſuppoſe the Place you are in to be 20 Deg. diſtant from the ſaid Meridian, then put the Sight Vane on the Arch of the Quadrant, juſt at the 20th Deg. And ſo as to any other Degree, which you ſuppoſe the Place you are in to be diſtant from the ſaid Meridian: And remember well, that at all Times and Places, when you are going to make your firſt Obſervation for Longitude, you be ſure to put the Sight Vane to that Deg. of the Quadrant, which you ſuppoſe the Place you are then in to be diſtant from the Meridian of the *Teneriff*. And having thus in right Manner trimmed your Quadrant, whilſt others are finding the Variation of the Compaſs;

IV. Then put the middle of the Radius of the Quadrant, into the Notch of the Top of the Pedeſtal, and faſten it there, by a Pin put through the Sides of the Notch, and the Middle of the Radius; and then let one ſtanding at the back ſide of the Quadrant, with his Hand turn it, with the Cape of the Pedeſtal, until he can ſee the Edge of the Radius, juſt over thoſe Degrees of the Compaſs ſtanding on its Shelf, that are found to be the true Eaſt and Weſt Points, after the Variation is allowed; and let him take ſpecial care to keep the Radius of the Quadrant thus due Eaſt, and due Weſt, until the Obſervation is finiſhed, which will be in a very ſhort Time.

V. Then let him that makes the Obſervation, look through the Sight Vane, and ſo turn the Horizon Vane, as that he can ſee through both the Vanes at once; and then if looking through both Vanes, he can ſee the Horizon cloſe to the Water, then the Diſtance between the Sight Vane, and no Deg. at the End of the Quadrant, contains the Number of the Deg. and Min. that the Place you are then in is diſtant from the Prime Meridian, *i. e.* the Meridian of *Teneriff:* But if looking through both Vanes he ſees the Water, or ſees the Sky only, then let him move the Sight Vane upwards or downwards, until he ſees the Horizon cloſe to the Water through both Vanes, and ſee what Deg. and Min. are cut by the Sight Vane on the Arch of the Quadrant; and then let him, and as many more as pleaſe, write down carefully the Number of the Deg. and Min. then cut by the Sight Vane, as being the Longitude of the Place you are then in, or its Diſtance from the Meridian of *Teneriff*; and if you be to the Eaſtward of the ſaid Meridian, then write down, that ſuch a Place lies in ſo many Deg. and Min. of Eaſt Longitude, as were cut by the Sight Vane; but if to the Weſtward of the ſaid Meridian, then write down, that the Place you are in lies in ſo many Deg. and Min. of Weſt Longitude. And thus your firſt Obſervation is finiſhed, which will make all others be more eaſy, when once you have untrimmed the Quadrant and its Pedeſtal, and carefully put up all their Utenſils in a Bag or Bags prepared for that Purpoſe, and laid the Staff of the Pedeſtal in a ſafe Place.

VI. A ſecond Obſervation cannot conveniently be made, until you have ſailed Eaſtward or Weſtward about four Leagues, but as many more as you pleaſe;

and then the ſecond and third, and all following Obſervations to the End of your Voyage, are to be performed as directed in the firſt Obſervation, and that in every Particular, excepting only this one, *viz.* That when you come to put the Sight Vane upon the Arch of the Quadrant, you be ſure always to place it to the very ſame Deg. and Min. which you had written down from the Obſervation next before it. As for Example, if the Deg. and Min. cut by the Sight Vane in the laſt Obſervation, and written down then, had been 15 Deg. 10 Min. then the next Time you go to make an Obſervation, be ſure that in putting on the Sight Vane, you place it to the 15 Deg. 10 Min. on the Arch of the Quadrant. And, *N.B.* that in all your Obſervations after your firſt, throughout your Voyage, when you come to put the Sight Vane upon the Quadrant, you be ſure to place it to the very ſame Deg. and Min. that was cut by it and written down at the Obſervation next before that, which you are then going to make; and then proceed in making your preſent Obſervation in all Things as you was directed in making the firſt Obſervation. And though you ſhould happen to be driven ſeveral ways by a Tempeſt, or be driven backwards; yet ſtill be ſure, when you come to make your next Obſervation, to place the Sight Vane to the Deg. and Min. written down at the Obſervation next before the preſent; and then by moving the Sight Vane upwards or downwards on the Arch of the Quadrant, until you can ſee the Horizon cloſe to the Water through both Vanes, the Deg. and Min. then cut by the Sight Vane, will ſhow how far you have been driven backwards or forwards from the Place in which you made your laſt Obſervation, by being ſo much more Eaſtward or Weſtward, according as you have been driven. And now, my brave Sailers, I have with no ſmall Care and Pains, endeavoured to ſhow you, how to find your Longitude at Sea, within 10 or 15 Min. at moſt: For if the Inſtruments be rightly made, as it is before directed; and if you take care to make Obſervations with them, as I have now ſhown you; by every Obſervation, you will know your preſent Diſtance from the Prime Meridian, *i. e.* of *Teneriff*, and thereby you will know your Longitude; as by knowing your preſent Diſtance from the Middle Line, you do thereby know your Latitude. And now I come to ſhow you a more eaſy Way of finding your Latitude, than hitherto you have known.

How to find the Latitude at Sea, with the ſame Inſtruments that find the Longitude.

AND firſt, theſe general Rules are to be obſerved, in making Obſervations for Latitude. And,

I. In order to find the Latitude, Obſervation is to be made only towards the South Point, or towards the North Point of the Horizon, which Point is to be known by finding the Variation of the Compaſs.

II. Obſervation is to be made to the South Point, if you intend to ſail, or are ſailing Southerly; and ſo toward the North Point, if you intend to ſail, or are ſailing Northerly.

III. No Obſervation is to be made towards any Horizon, but what is pretty clear, and when the Sea is not ſo rough as to make the Ship tumble.

IV. It is convenient that the Ship ſhould lie by, during the ſhort Time of making Obſervation.

PATENT OFFICE LIBRARY.

Particular Rules in making Obſervation for Latitude.

I. HAVING finiſhed your Obſervation for Longitude, if you be ſailing Southerly, turn the Ship ſo as that one Side of her lies towards the South, and bring the Pedeſtal, with all its Utenſils, and place it near the South ſide of the Ship, and find the Variation of the Compaſs, as it ſtands there on its Shelf, leſt it ſhould have varied by being removed. Or if you are minded to make Obſervation towards the North Horizon, then place the Pedeſtal on the main Deck near the North ſide of the Ship, and then find the Variation of the Compaſs.

II. Then conſider, whether the Place you are in be to the Northward, or to the Southward of the Middle Line, and whether you be going toward the ſaid Line, or going from it; and if you are going towards the Middle Line, whether Northwards or Southwards, be ſure to turn that End of the Quadrant uppermoſt, that is marked 0, 1, 2, 3. but if you are going from the Middle Line, whether Northward or Southward, then be ſure to turn that End of the Quadrant lowermoſt, which is marked 0, 1, 2, 3. So that the End of the Quadrant marked thus, is always to be uppermoſt, when you ſail toward the Middle Line, and lowermoſt when you ſail from it. And having thus turned the Quadrant as it ſhould be turned when you go to obſerve for Latitude, put the Vanes on the Eaſt ſide of the Quadrant when you ſail Southward, and are going to make Obſervation towards the South Horizon; but on the Weſt ſide, when you ſail Northward, and are going to make Obſervation towards the North Horizon; and in putting on the Vanes, place the Horizon Vane, as was before directed in making Obſervation for Longtitude. And in putting on the Sight Vane, place it at your firſt Obſervation to the Deg. and Min. of the Quadrant, which you ſuppoſe the Place you are then in to be diſtant from the Middle Line; but in all following Obſervations, place the Sight Vane to the Deg. and Min. cut by it at the Obſervation next before, as it was alſo directed before. And having thus trimmed your Quadrant in right manner, whilſt others are finding the Variation of the Compaſs, then,

III. Place the Middle of the Radius of the Quadrant in the Notch in the Top of the Pedeſtal, and pinning it there, let one ſtanding at the Back of the Quadrant, ſo turn it and the Cape of the Pedeſtal, as that he may ſee the true North and South Points of the Compaſs, its Variation being known, juſt under the Edge of the Radius, and ſo let him keep the Radius due South and North, until the Obſervation is finiſhed.

IV. Let him that makes the Obſervation, look through the Sight and Horizon Vanes, and move the Sight Vane upwards, or downwards, until he can ſee the Horizon cloſe to the Water, the Quadrant ſtanding due South and North, and the Pedeſtal ſtanding perpendicular; and then the Deg. and Min. cut by the Sight Vane, will be the Latitude of the Place you are then in; and therefore write them down carefully.

V. When you have ſailed about four Leagues or more to the Northward or Southward, and are minded to make another Obſervation for Latitude, you are to make it juſt as before directed, ſave that in putting on the Sight Vane, you are to place it to the very ſame Deg. and Min. of the Quadrant that were cut by it, and written down the Obſervation next before; and continue to place it ſo in all Obſervations for Latitude throughout your Voyage; and ſo the Sight Vane being placed right in the Beginning of all your future Obſervations, you have no more to do but to move it upwards or downwards, until you can ſee the Horizon cloſe to the Waters through both the Vanes; and then the Deg. and Min. cut by the Sight Vane, will be the Latitude of the Place you are then in; and ſo of all other Places where you obſerve for Latitude. And thus, brave Sailers, I have endeavoured to ſhow you how to find your Latitude at Sea within 10 or 15 Min. of the Truth at moſt, with the ſame Inſtruments that find the Longitude, and without any Calculation, or any Regard to the Sun's Shining, or the Sun's Declination; ſo that if you have a clear Horizon, and ſo calm a Sea as not to make the Ship tumble, you may by this excellent Inſtrument find both the Longitude and Latitude of any Place you may be in at Sea, to your own Satisfaction, provided the Inſtruments be rightly made, and Obſervation be made with them as before is ſhewn. And further, when you have made Obſervation toward the Weſt Horizon, when you are ſailing Weſterly; if the Eaſt Horizon happens to be clear at the ſame time, then pray make Obſervation towards the Eaſt Horizon alſo, to try whether there be any Difference or no; and if you find that the Difference, if any be, will be no Damage, then you may make your Obſervation towards the cleareſt Horizon, whether you be ſailing towards it or not, and that both in finding your Longitude and Latitude; and this would help you, if it anſwers Expectation, to make a great many more Obſervations than you could do if you was confined only to that Horizon, towards which you are ſailing.

Moreover, when by contrary Winds you are forced to ſail, perhaps, five or ſix ſeveral Courſes; then ſo ſoon as the Horizon is clear, and the Sea moderately calm, make Obſervations both for the Longitude and Latitude, as above directed; then work your Traverſe; and then if, by conſidering and comparing, you find that your Obſervations let you know your preſent Longitude and Latitude, and how much you are gone backward or forwards, as well as working your Traverſe; then you need never work your Traverſe any more, unleſs the keeping of your Dead-Reckoning does oblige you to do it. And now I ſhall put an End to this hard and difficult Task, when I ſhall have ſuggeſted two or three

Things to the Sailers, which ſeem to be convenient for them. And,

I. When they add the Sums of the Deg. and Min. of their ſeveral Obſervations, both for Longitude, and Latitude, it ſeems convenient, that they ſhould add to each Obſervation, the Sum of 5 Min. becauſe it is probable, that the Surges on the Face of the Waters, will hinder the Sight of the Obſerver, from reaching the Extremity of the Horizon, by 5 Minutes at leaſt; or if it does not, it will only make the Reckoning to be a little a-head of the Ship, which is the ſafeſt Way.

II. It ſeems convenient, that they ſhould keep their Dead-Reckoning very carefully, in the uſual Manner, or in a better, if they can find one, from the Beginning to the End of their Voyage; that ſo they may have ſome tolerable Knowledge how they proceed, in Caſe of ſuch hazy Weather, as will allow them to make no Manner of Obſervations, for Longitude, or Latitude.

III. It ſeems convenient, that they ſhould find the Variation of their Compaſs, three or four Times every Day, and every Night too, if they can; becauſe when their Compaſs varies, and they are not aware of it, then it leads them out of their Way. And therefore I would adviſe all Sailers to be very expert and dextrous in finding the Variation of their Compaſs, that ſo they may do it readily and ſurely, in the many Times they ſhall have Occaſion for it.

IV. In Voyages through the *South-Sea*, or to the *Eaſt-Indies*, when they do not ſail up to the 90th Degree from the prime Meridian, which 90th Degree may be called the Eaſt Point, or the Weſt Point, it is convenient, when they ſail by the ſaid Point to the Northward, or to the Southward, and think they are near the Meridian of it, then to add the Degrees and Minutes of their laſt Obſervations for the Longitude, and Latitude, into one Sum; and if that Sum be 90, then they are at the Meridian of the ſaid Point; if it be leſs than 90, they are not come to it; but if it be more, they are paſt it; and then they are going towards the prime Meridian, and therefore ſhould turn that End of the Quadrant uppermoſt which has no Deg. or Min. and alſo diſcount their Degrees, as if at 67, then after 66, 65, 64, *&c.* and do ſo in returning, as well as going out: And the like ſhould be done as to the Latitude, in paſſing by the Poles.

Thus, my brave Sailers, I have given you the beſt Aſſiſtance I can, which, I doubt not, will be beneficial to you, if ye ſtrive to live in the Fear of God, by whoſe Bleſſing, may Safety, Health, and Proſperity ſtill attend you. *Amen.*

POSTSCRIPT.

ALTHOUGH the Longitude at Sea may be found by the forementioned Inſtrument, as well and truly as need be deſired; yet ſince it has been the Cuſtom hitherto, in all Places to the Northward, and to the Southward of the Latitude of 30 Degrees, to allow to a Degree of Longitude, ſometimes but 50 Min. ſometimes 40, ſometimes 30, ſometimes 20, and ſometimes but 15 Min. to a Degree of Longitude: And ſince the foreſaid Inſtrument does ſuppoſe a Degree of Longitude to contain, in all Places, no leſs than 60 Min. it cannot be expected, that the ſaid Inſtrument ſhould find the Longitude of any Place, according to the Maps, Sea-Cards, or Tables of Longitude that are now in uſe; becauſe they are made according to theſe lame, maimed, and curtailed Degrees of Longitude, and do not allow 60 Min. to every Degree, as it ought to be, according to the uſual and well-known Rules in Mathematicks: And therefore, to avoid any Miſtake that may happen on this Account, I adviſe all Sailers, the firſt Time they take the foreſaid Inſtrument to Sea with them, they would find their Longitude after the uſual Manner, all their outward-bound Voyage; But at the ſame Time, I deſire and intreat them, to make Obſervation with the ſaid Inſtrument, at the Place of their Departure, at all remarkable Places in their Voyage, and at the Place where they unload, or have Occaſion to anchor; and to write down carefully the Deg. and Min. which the ſaid Inſtrument gives and ſhows to be the Longitude of the Place where they obſerved, and to write down the Name of each particular Place alſo; and then, when they return Home, and for ever after, they may find the true Longitude of all theſe Places, according to the careful Obſervations which they made when outward-bound: And if they will publiſh the Journal of theſe Obſervations, it will be a Guide to all Sailers that ſhall have Occaſion to go the ſame Voyage; And then, when they once have gone all their uſual Voyages, and alſo have publiſhed the Journals of their Obſervations, as aforeſaid, then Maps, Sea-Cards, and Tables of Longitude may be made, according to the true Longitude of Places, found by this excellent Inſtrument. And I hope the Sailers will not grudge, or think much of their taking ſo much Pains and Care about this Affair, ſince they may be ſenſible, that it cannot be done without their Care; that it will tend to their own Preſervation and Welfare, and perfect and compleat the ſo long, and ſo much deſired right Invention of the Longitude; And beſides, I very much doubt, that the Wit of Man can deviſe a Method, of finding both Longitude, and Latitude, ſo ſurely, and ſo exactly, and by an Inſtrument of leſs Charge, than what I here now offer. So, hoping the Lord will bleſs my Endeavours, to ſerve the brave Sailers, I commit them to his Almighty Protection.

I M-

PATENT OFFICE LIBRARY

IMPROVEMENTS IN PHILOSOPHY.

An Endeavour to make ſome Amendments in the preſent Accounts of the Syſtem, and the principal Phænomena of this viſible World.

ALL the Syſtems I have ſeen, or heard of, are the *Ptolemean*, the *Copernican*, and *Tychonean* Syſtems. And though all of them have ſome Things right, yet each of them ſeems to me, to have ſome conſiderable Defect in it. The true Syſtem, therefore, of this viſible World, ſeems to me to ſtand thus: The Earth is the Center of this viſible World; and next above the Earth, is the Moon; next above the Moon, is the Sun; next above the Sun, is *Mercury*; next above *Mercury*, is *Venus*; next above *Venus*, is *Mars*; next above *Mars*, is *Jupiter*; and next above *Jupiter*, is *Saturn:* And theſe five uppermoſt, *viz. Mercury*, *Venus*, *Mars*, *Jupiter*, and *Saturn*, ſeem to be already ſufficiently accounted for by the Learned: And therefore, I ſhall ſay no more of them. But as to the Sun, the Moon, and the Earth, ſomething more ſeems needful to be ſaid of them, than I have as yet met with.

Of the SUN.

AND firſt, of the Sun, which is the principal Light of the viſible World, without which moſt Animals, but eſpecially Mankind, would have but a dark and diſmal Habitation upon the Earth. The Appearance of the Sun, and his ſo great Light, and Heat, do ſhow him to be a great Globe of burning and flaming Fire; and ſince the ſame Globe has been burning and flaming, ever ſince the Creation of the World, and yet is no Ways leſſened, or conſumed; this, if there was no more, does prove the Being of God; ſince none but a Being of infinite Power and Wiſdom could keep ſo great a Globe of Fire continually burning and flaming, without being any Ways conſumed or waſted. The great Heat of the Sun ſerves for ſeveral Uſes; as firſt, it draws up ſo many Vapours, Steams, and Reeks, from the Surface of the Waters, and moiſt Places of the Earth, as are the principal Cauſe and Original of almoſt all the Rains, Dews, Snows and Hail, that fall down from the Clouds. Indeed, ſome moiſt Vapours may be raiſed up a little Way by the Winds; but then it ſeems to be chiefly by the Heat of the Sun, that theſe are mounted up to the Clouds, becauſe Wind would rather drive them before it, than mount them up. Alſo the Heat of the Sun, draws up out of ſome Places of the Earth, ſome nitrous and ſulphurous Vapours; and theſe being lighter than Vapours out of the Waters, are eaſily carried up higher; and when theſe come near the Sun, his Heat inflames them, and makes them ſhoot out Flaſhes of Lightning, which ſeems to be the Cauſe of thoſe Flaſhes of Lightning which happen when there is no Thunder: But then, when theſe nitrous and ſulphurous Vapours happen to be inflamed, and at the ſame Time, ſome Winds happen to drive them upon watery Clouds, then the Fire and Water meeting together in great Quantities, do make that terrible Sound and Noiſe, which is called the Thunder;

ſo that the Winds driving inflamed Vapours among watery Clouds, in great Quantities, ſeems to be the real Means by which the glorious God maketh the Thunder, *Pſalm* xxix. 3. Alſo the great Heat of the Sun does warm the Face of the Earth, and with the Fatneſs of the Earth, does make, as it were, a Fomentation to the Seeds and Roots of Trees, Plants and Herbs, which makes them ſpring up, and grow on the Face of the Earth, for the Suſtenance of Man and Beaſt, according to the divine Appointment, *Pſalm* civ. 13, 14, 15. Laſtly, the great Heat of the Sun, where it comes, in Order to facilitate its raiſing of Vapours, does rarify, extend, and expand the Body of the Air, that is between the Sun and the Earth; and ſo the Air being expanded and extended, does preſs ſo hard upon the Face of the Waters under it, as that it forces them to run out where they can find any Deſcent to avoid the Preſſure: And this Extenſion of the Air, and its Preſſure on the Waters, ſeems to promote Tides, and helps to raiſe Winds, as may be ſhown afterward. And thus having ſhown the ſeveral Effects of the Sun's Heat, the Sun's Motion comes next to be conſidered; and this Motion of the Sun is only round the ecliptick Circle once every Year; yet not with one and the ſame Place, but ſeems to proceed faſter about the Equinoctials, than about the Tropicks; which ſeems to be by divine Appointment, that ſo the Climates which lie far North or far South, may have the Benefit of his Heat and Warmth for the longer Time. And ſince the Sun keeps ſuch a conſtant and annual Motion, then he may be made to ſtand ſtill, *Joſh.* x. 12, 13. or to go backwards, 2 *Kings* xx. 11. by the ſame Almighty Hand that makes him proceed in his annual Courſe. The Effects of this Motion of the Sun are the Seaſons of the Year, Summer, Autumn, Winter, and the Spring; the Equinoctials; the ſometimes longer, and ſometimes ſhorter Days, both to Northern and Southern Climates; and that between 40 Deg. of Lat. in each ſide the middle Line, the Air is exceſſive hot; from 40 to 60, moderate; from 60 to each of the two Poles, the Air is exceſſive cold. And ſo much ſhall ſuffice concerning the Sun.

Of the MOON.

As to the Moon, ſhe ſeems to be a compleat Globe; but yet ſeems to be only an opake Body, that has no Light

of

of its own, but only reflects Light upon the Earth, which comes to her from the Sun: And as to her Surface, moſt Part of it, if not all, ſeems to be covered with Water, or Glaſs, or Cryſtal, or ſome other Thing that is apt and meet to reflect Light; and therefore what ſome affirm, that through their Teleſcopes they have ſeen the Surface of the Moon much like the Surface of the Earth, ſeems to me very improbable; becauſe when the Air is clear and ſerene, the Moon reflects the Sun's Beams upon the Earth with as clear a Light as could be expected, tho' the Moon's Surface was cover'd with Looking-glaſs; and that ſeems impracticable, unleſs the Moon could turn and keep the Side of her, which is covered with Waters and Seas, always towards the Sun. Beſides, the Moon was made to be a leſſer Light to rule the Night, with the Stars, *Gen.* i. 16. And therefore ſince ſhe was to have no Light of her own, but what ſhe borrow'd from the Sun, there is no Doubt to be made, but that the moſt wiſe Creator did give her ſuch a Surface, as is moſt meet and convenient to fulfil the End of her Creation; which could not be expected, if her Surface was like that of the Earth. Moreover, the Moon ſeems to be the leaſt of all the Planets; and ſo ſhe had need to be, that ſhe might be the more meet for Motion; of which ſhe ſeems to have gotten a double Portion, in reſpect to the other Planets; for the Moon has both an Annual and a Monthly Motion. Her Annual Motion is round the Ecliptick Circle, once every Year; but ſo as that ſhe ſeems to be always in that Sign of the Ecliptick, which is diametrically oppoſite to the Sign which the Sun is in at the ſame Time. So that when the Sun is in *Aries*, the Moon is in *Libra*; when the Sun is in *Cancer*, the Moon is in *Capricorn*; and ſo of all the reſt of the Signs. Now the Annual Motion of the Moon, ſeems to be the Cauſe why the Eclipſes of the Moon happen when ſhe is about the one Tropick, and the Sun about the other; as alſo, that when the Southern or Nothern Climates have the longeſt Days, then the Moon is fartheſt from them, and they have leaſt of her Light; but when theſe Climates have the ſhorteſt Days, then the Moon is neareſt to them, and they have moſt of her Shining, that ſo, as much as ſhe can, ſhe may ſupply the Sun's long Abſence in the ſhort Days. The Monthly Motion of the Moon, is that by which ſhe goes round the Earth from Eaſt to Weſt once in every Month, or twelve Times in every Year; but for the Exactneſs of the Time I muſt refer the Reader to a late *Theory of the Moon* by Dr. *Halley*. This Monthly Motion of the Moon, conſidering her Diſtance from the Earth, muſt be very ſwift and rapid, and therefore muſt make great Impreſſion upon the Air, and make a large Body of it to accompany her Motion, and thereby help to promote Winds of ſeveral Sorts. Alſo this Monthly Motion makes the New Moons, Full Moons, and their Quarters; for when the Moon is in the ſame Meridian with the Sun, who is above her, ſhe muſt then reflect all her Light upwards, and none upon the Earth; but when ſhe is a Day's Journey paſt the Sun, then his Light touches a ſmall Arch of her towards the Earth, which the Moon immediately reflects on the Earth, and we call it the New Moon. And as the Moon goes farther from the Sun, ſtill more of her Face is enlightened, until ſhe is 90 Deg. diſtant from the Sun; and then half an Hemiſphere of her is enlighten'd; and that we call the firſt Quarter. And as the Moon goes farther from the Sun, ſtill more of her Face is enlightened, until ſhe comes to be 180 Deg. diſtant from the Sun, and then an whole Hemiſphere of the Moon is enlightened; and that we call tht Full Moon. But then afterwards the Moon begins again to draw nearer to the Sun, and ſo her Hemiſphere, that was all enlightened, begins by little and little to be darkened again; for though a whole Hemiſphere of the Moon be always enlightened by the Sun, except when the Earth is between them; yet the Sun being always above her, the Roundneſs of her Figure or Shape will not ſuffer her to reflect Light upon the Earth from a whole Hemiſphere, but then only when ſhe is 180 Deg. diſtant from the Sun. And as ſhe draws nearer and nearer to the Sun, ſo ſhe reflects his Light from leſs and leſs of her Hemiſphere, until ſhe comes to be but 90 Deg. diſtant from the Sun; and then ſhe reflects Light only from half her Hemiſphere; and that we call her laſt Quarter: And then as ſhe draws nearer and nearer to the Sun, ſhe reflects Light from leſs and leſs of that half Hemiſphere, until coming up with the Sun, and being on the ſame Meridian with him, ſhe reflects his Light only upwards, but none towards the Earth; and then ſhe has performed her Monthly Circulation. Laſtly, this Monthly Motion of the Moon occaſions the Eclipſes of the Sun, to happen for the moſt Part, if not always, at the Time of the New Moons, which are neareſt to the

Equinoctials, and that whether before or after the Equinox. And ſo much concerning the Moon for the preſent.

PATENT OFFICE LIBRARY

Of the EARTH.

THE Earth, or the whole Body of the Land and Seas, ſeems to be a compleat Globe, if you except thoſe Heaps and Hills of Snow, and thoſe thick and high Banks of Ice, which are continually about its two Poles. And the Earth has but one Motion, which is from Weſt to Eaſt, round its own Axis, in the ſhort Time of every 24 Hours: For though it be ſaid, *Pſal.* xciii. 1. That the World is ſtabliſhed, that it cannot be moved; yet that is meant of the whole Syſtem of this viſible World; or if it be meant of the Earth, then it ſeems to import only this, that it ſhould not be removed out of its own Place, and from being the Center of this viſible World; but ſeems no way to hinder its being moved in its own Place, and only round its own Axis; for, ſince in ſeveral Places of Holy Scripture mention is made of the Earth's being moved; ſee *Pſal.* xviii. 7. lxviii. 8. xcix. 1. *Iſa.* xxiv. 19. *Jer.* iv. 14, and xlix. 21. that ſhows that the Earth is not abſolutely and in all Reſpects im-

immoveable; and therefore I hope I ſhall ſay nothing contrary to the *Word of God*, though I affirm that the Earth is moved round its own Axis once in every 24 Hours. And this Motion of the Earth ſerves for ſeveral Uſes, and is the Cauſe of ſome notable Effects; the firſt of which is, that it makes the Days and Nights, the Evenings and Mornings, the Sun Riſings and Sun Settings, and the Riſing and Setting of the Moon and Stars. A ſecond Effect of the Earth's Motion round its Axis, is this, *viz.* It is the firſt and principal Cauſe of the Tides, or the Ebbing and Flowing of the Seas; for that the Attraction of the Moon, or of the Sun, or of both, ſhould be the Cauſe of the Tides, ſeems to me to be altogether improbable; becauſe, if the Attraction of the Moon or Sun did cauſe the Tides, then certainly the Tides would be higheſt always between the Tropicks, and in Places next to them; for there the Sun and Moon always are, and therefore if they did draw up the Waters, and make them ſwell higher, certainly they would do it moſt in the Places that are nigheſt them, and juſt under them. But now the Experience of all Ages proves, that in theſe Places the Tides ate loweſt, but much higher in Places far diſtant; for in Places between and near the Tropicks, the Tides ſeldom riſe above two Foot, unleſs it be by Reaſon of ſome Hurricane, or ſtormy Winds: Whereas, in Places far North, or far South, perhaps to the Latitude of 50 or 60 Degrees, the Tides riſe four or five, and ſometimes ſix or eight Foot; which would be moſt unaccountable in Places ſo far diſtant from the Sun and Moon, if it was their Attraction, that raiſed the Tides, and made the Waters ſwell ſo high. Wherefore, ſome more probable Cauſe of the Tides muſt be ſought for.

Of the TIDES.

THE firſt and principal Cauſe of the Tides, ſeems to me, to be the Motion of the Earth round its Axis: For the Waters of the Seas, being contained in hollow Places on the Surface of the Earth, as in a Veſſel; the whirling Motion of the Earth round its Axis muſt needs keep the Waters in a whirling Motion alſo; and the Earth being globular, and ſo higher between the Tropicks, than it is towards the North and South, as appears by the Moon being ſeen ſooner, the Thunder being heard louder, and the Rains falling much heavier, between and near the

Tropicks, than in other Places, which ſhows that Climate to be nearer the Clouds, and therefore higher than other Places; and the Motion of the Earth beginning from the Weſt, when that Quarter of the Earth which is next the Weſt, begins to turn up towards the Zenith, the Waters upon it being put in Motion, by the ſwift Motion of the Surface of the Earth, which runs or turns round 900 Miles in every Hour; theſe Waters, I ſay, being diſturbed and moved exceſſively by ſuch ſwift Whirling of the Earth, and finding a Deſcent towards the North and South, they, of their own Accord, run upon the Deſcent, and ſo continue running, until that Quarter of the Earth, which was next the Weſt, is come uppermoſt towards the Zenith, which is the Space of ſix Hours: But then the Waters being ſtopped by the Land and Shores, and that Quarter of the Earth from which they deſcended, beginning now to turn downward toward the Eaſt, they alſo turn, and follow the deſcending of the Place they came from, and ſo continue running towards the Deſcent for other ſix Hours, and ſo make one Tide, and one Ebb, in the Space of 12 Hours. And as the other Hemiſphere of the Earth comes upwards, the Waters of the Seas run upon the Deſcent Northward and Southward for ſix Hours, and then turn, and run upon the Deſcent for other ſix Hours, in the Manner before-mentioned, and ſo make another Tide, and Ebb, in the next 12 Hours: And thus the Earth's Motion round its Axis, ſets the Waters of the Seas in a violent Motion, which makes them, according to their natural Inclination, run upon the firſt Deſcent they meet with until they are ſtopped, and then they turn and run in the next Deſcent; and by doing ſo twice every Day, they make two Tides and Ebbs every Day. As to the Tides being higher at full, and new Moons, and at the Equinoctials, the Reaſon ſeems to me to be as follows: It is certain from Experiments, that the Air has great Weight in it, which is moſt eaſily felt upon the Surface of Fluids; and at full Moon, the Moon reflects the Sun-Beams upon the Earth from her one Hemiſphere; and then ſuch a Multitude of Sun-Beams reflected from the Moon, as from the Face of a Burning-Glaſs, do heat, rarify, and expand the Air; and being, at the ſame Time, diſturbed by the eaſterly Motion of the Earth, and weſterly Motion of the Moon; theſe Things make the Air preſs hard upon the Face of the Waters, when running out in Tides, as before mentioned; and that Preſſure makes them run out more plentifully, and ſo makes the Tide be higher; and eſpecially about the Equinoctials, when the Sun and Moon are both in the Middle of the hotteſt Climate, the Sun-Beams reflected from the Moon muſt then be much hotter, and ſo rarify the Air more, and make it to preſs harder on the Face of the Waters, which, to avoid the Preſſure, muſt run out more plentifully, and ſo make the Tide ſtill higher: And then at the new Moons, the Sun and Moon being in one and the ſame Meridian, the Air muſt be very much heated and expanded by the Preſence of the Sun, and being alſo diſturbed by the contrary Motions of the Earth and the Moon; theſe muſt needs make the Air preſs hard on the Face of the already running-out Waters; and eſpecially about the Equinoctials, when the Moon is juſt under, or almoſt under the Sun, and in the Middle of the hotteſt Climate, ſuch great Heat and Diſturbance of the Air, muſt needs dilate and expand it, and make it preſs ſtill harder on the Face of the running Waters, and ſo make them run out ſo very plentifully, as to make the higheſt Tides of any at the Equinoctial New

Moons. And ſo much concerning the Tides. And as the Motion of the Earth is thus the firſt Cauſe of the Tides, even ſo the Tides are the firſt Cauſe of the continual running Rivers and Fountains: For that the Rains, Snows, and Dews, ſhould be their Cauſe, ſeems to me altogether incredible; for Rains and Snow fall but now and then, not every Day; but theſe Rivers and Fountains run continually Night and Day: How then can that, which comes but only ſome Times, be a ſufficient Supply for a perpetual Expence? Again, if the Earth be dry when Rain falls, it drinks up a good Part of it, and the reſt runs away upon Deſcents: And if the Earth be moiſt, then almoſt all the Rain runs away upon Deſcents: How then can that which is drunk up, or runs away, ſupply continually running Fountains? It's true, melted Snow and Rains increaſe the Streams and Currents of Rivers and Fountains, and make them overflow their Channels; but then, when that Increaſe is by Deſcents run away into the Sea, yet ſtill the Rivers and Fountains continue to run on with their uſual Streams, which are neither leſs nor more, than they were before the Rains fell. It is certain from Sight, that the far greateſt

Part of Rains and melted Snow, do run with all the Haſte they can by Deſcents into the Sea: How then ſhould the ſmall Remainder ſupply Fountains and great Rivers, that are continually running out? The ſmall Hole of a Foſſet will let out a Tun-full of Liquor in leſs than 24 Hours, How then ſhould the now and then falling Rains ſupply ſuch Rivers, as run out a Tun and more in every Minute? Beſides, moſt of the Fountains and Rivers do iſſue out of the Sides of Mountains and Hills; but then the Rains and Snow that falls upon them, finding a Deſcent every Way, does run down ſo faſt and ſo throughly, as not to leave Moiſture enough to make good Graſs grow upon Hills or Mountains: How then can it be poſſible, that they ſhould ſupply ſuch great Currents of Waters, as if the greateſt Mountaïn was a hollow Ciſtern filled with Water, could not ſupply but for a ſhort Time?

Of the true Cauſe of Fountains.

THE Tides, then, muſt be the true Cauſe of Fountains; which filling all the Channels of the Sea with running Water twice every Day, theſe Waters find Paſſages under the upper Cruſt of the

Earth, in Beds of Sand, and ſmall Spaces between Rocks and Stones, and in ſpungy Places in the Bowels of the Earth, through which they keep running from one Paſſage to another, until they go to the farthermoſt Parts of the dry Land: For as the Bodies of Men and Beaſts have Veins, by which the Blood and Nouriſhment is conveyed to all the extream Parts of their Bodies; even ſo the Earth ſeems to have ſuch Veins and Paſſages in it, as convey the Waters of the Sea unto all Parts of the dry Land, to ſatisfy the Thirſt of dry-land Animals, when Rains and Dew are with-holden; inſomuch that there are not many Places of the dry Land; but if you dig a few Fathoms, ſo much Water will come into the Pit you dug, as will be ſufficient to ſerve a Family and their Cattle. And as the Waters of the Sea are thus ſent out through the dry Land by ſubterraneous Paſſages, it ſometimes happens, that a conſiderable Quantity meeting, and becoming a ſmall Stream, the ſame, after running ſome Time in a Valley, is pent up on all Sides by Rocks, Stones, and ſtiff Clay; but finding only Earth above it, it riſes and ſoftens the ſaid Earth, and diſſolves it into Dirt and Mud, and ſo the Stream makes a Paſſage out to itſelf, and then it comes bolting up out of the Earth like a boiling Pot. Sometimes again, a Stream running in a ſubterraneous Paſſage, happens to come under ſome large, hollow Place in the Surface of the dry Land, and there finding the Earth above it ſomewhat thin, it diſſolves it as aforeſaid, and breaks out, and ſo covers the Bottom of that hollow Place with Water, and makes it ſoft; and then other Streams happening to come under the ſaid ſoftened Bottom, they alſo break out there, and ſo fill all that large hollow place with Water up to the Brim, ſo that it becomes a Lake; and being full to the Brim, all the Streams that come into it join into one, and finding a Deſcent over ſome Place of the Brim, they run out all in one Stream, which in ſome Places is very large; and this ſeems to be the true Reaſon, why ſeveral Rivers, both great, and ſmall, have their Fountain-Heads in Lakes: But then, moſt Part of the Waters coming from the Tides, and running through ſubterraneous Paſſages, do keep running on by ſeveral Windings and Turnings, until they come under the Foot of ſome Hills or Mountains; the Bodies of which being Heaps of Rocks, and Stones, and ſome Earth, confuſedly caſt together, the Streams of Water that come thither, are, for the moſt Part, ſo pent up on all Sides, as that they can find no Paſſage, but only upwards, between the Rocks and Stones; where they run often to the Tops of Hills, and the Middle of Mountains; and there coming near the Surface, through the Tapering of the Mountain, they break out, and run down to the Vallies; and ſo through ſuch Deſcents as they meet with, they run on to the Sea from whence they came: And the Waters thus running upwards in Hills and Mountains, may be eaſily accounted for; becauſe it is proved by many Experiments, that Waters running from any high Place, if they be pent in cloſe on all Sides, and only have Liberty upwards, they will run upwards until they be on a Level with the high Place they came from; even ſo here, the Tide-Waters coming from between the Tropicks, the higheſt Place of the Earth as it turns upon its Axis, and running on till they come under the Foot of Hills or Mountains, and being there kept cloſe on all Sides, except only a Paſſage upwards, they riſe and run upwards, until they be on a Level with the Earth between the Tropicks, and that brings them to the Middle of Mountains, and to the Tops of ſeveral Hills: Neither are theſe bare or groundleſs Suppoſitions, but what ſeem to be warranted from what is ſaid of the Waters, in *Pſalm* civ. *Ver*. 8. *They go up by the Mountains, they go down by the Vallies*; and *Ver*. 10. *He ſendeth the Springs into the Vallies, which run among the Hills.* And to ſhow that theſe Waters come from the Sea, he ſpeaks of the Waters that come from the Clouds afterwards, ſaying, in *Ver*. 13, 14. *He watereth the Hills from above, he maketh the Graſs to grow for the Cattle, and Herbs for the Service of Men.* From which Texts it ſeems plain, that the Waters which ſpring out of Hills and Vallies, do not come from above, becauſe they cannot make the Graſs and Herbs to grow, unleſs it be by the Sides of their Streams, and therefore they muſt come from the Sea: And yet theſe are the Waters, which go up by the Mountains, and down by the Vallies, and run among the Hills. From all which Things it ſeems to be certain, that the Tides of the Sea are the true Cauſe of the continually running Rivers and Fountains: For as to ſome Fountains ceaſing to run in Times of great Drought, the Reaſon ſeems to be, becauſe theſe Fountains run near the Surface of the Earth for ſome conſiderable

derable Space before they break out, and ſo the Surface of that Space being dried and parched by the Drought, it drinks up the Waters of that Fountain before they can reach its Vent: And then as to Fountains not being ſalt, as the Waters of the Sea are; if a Fountain breaks out within a League or two of the Sea, it is commonly brackiſh; which ſhows that it comes not from the Rain which is ſweet, but from the Sea; but when the Waters of a Fountain have run three or more Leagues from the Sea, the Earth, and Beds of Sand, and Rocks, and Stones, among which they run out, takes off their brackiſh Taſte, and ſweetens them. And here I deſire the Reader, with me, to admire and adore the Goodneſs and Kindneſs of Almighty God, in making the Waters of the Sea to be full of Salt; partly that they may not corrupt and ſtink, ſo as that there could be no ſailing over them; and partly to produce Salt to ſeaſon all Sorts of Fleſh, which he has allowed to be Meat to Mankind ever ſince *Noah*'s Flood: And yet, becauſe the Sea Waters would not be wholſome Drink for Man or Beaſt that live on dry Land, he has made the Sun to draw up only freſh Waters from the Salt Sea; and made the

Sea Waters, by running through the Veins of the Earth, to loſe their Saltneſs, and to become ſweet and freſh at all Fountain Heads, unleſs it be a few Mineral Fountains, which may be medicinal to Mankind. And ſince it is He that ſends the Springs into the Vallies, and makes them run among the Hills, we have no Reaſon to doubt that the Fountains riſing in the higheſt Places of Mountains, do come from the Sea, if we conſider, that by the Art of Man, the Waters are often made to run a great way on a ſmall Deſcent, and ſometimes on a Level, if there be but a ſmall Deſcent at laſt; as alſo that they are made to riſe to very great Heights, and fall again, and to riſe again to the like Height, by Engines of Man's Invention: And therefore it cannot but be highly credible, that they are made to do all that I have ſuppoſed of them, by the Will and Power of Almighty God. And ſo much concerning the Origin of Fountains.

But then here ariſes a moſt difficult Queſtion, concerning ſome Seas which have great Currents of Waters into them, and yet have no Tides, nor no viſible Out-lets; of which Sort are the *Mediterranean*, and the *Caſpian* Seas; and as to theſe, I have met with an ingenious Experiment,

periment, by which it is endeavour'd to be proved, that ſo great Quantities of Waters are raiſed by the Sun and Winds from the Face of the Seas, as do exhauſt all the Waters that run into theſe Seas, and rather more; and that ſo great Exhalation of Vapours by Sun and Winds, makes them neither to over-flow, nor to need any Outlet. And indeed if the Waters raiſed by Sun and Winds were intirely conſumed, or carried quite away never more to return, it would not only keep theſe Seas from over-flowing, but even diminiſh them in proceſs of Time; but then it is certain, that the Waters raiſed out of the Seas by Sun and Winds, being carried up to the Clouds, do all fall again in Rains, Snow, Hail, or Dew; and what falls not into the Sea, but on dry Land, runs all again into the Seas by Deſcents, except only ſo much as ſerves to make Trees, Plants, Herbs, and Seeds grow on the Earth, and to ſerve for Petrification, or Concretion of Stones; and that not being the ten Thouſand Part of the Waters raiſed by the Sun and Winds, it cannot poſſibly hinder thoſe Seas from over-flowing, which have great Currents of Water running daily into them, and yet no Out-let. And that the Waters, raiſed by the Sun and Winds, do almoſt all return

turn to the Seas again, muſt be allowed; becauſe the foreſaid Experiment proves ſo great Quantities to be raiſed daily, as, if they did not return to the Seas again, would before this Time have almoſt emptied the Seas, and made them ſo ſhallow, as not to be able to carry a Ship of 100 Tons to the *Indies.* And if the Waters raiſed by the Sun and Winds, do almoſt all return to the Seas again, then they cannot hinder thoſe Seas from over-flowing, which have great Currents of Water running daily into them, and yet no known Out-let. Some other Account therefore muſt be given of this Matter, and it will be hard to give a good Account. What ſeems to me moſt probable is as follows.

Concerning the Mediterranean *and* Caſpian *Seas.*

AS to the *Mediterranean* Sea, the Difficulty ſeems almoſt inſuperable, becauſe of the many great Rivers that run daily into it; beſides the great Current of Water that ſets daily into it from the Ocean, through the *Streights* of *Gibraltar*, as Sailers unanimouſly atteſt; which if it has no Out-let, would be ſufficient to make it over-flow a great Part of *Europe.* However,

ever, there be theſe two or three Things, which ſeem to be the moſt likely Things to hinder its over-flowing, *viz.* Firſt, ſince the great Rivers that run into it, are near the Eaſt End of it, or at leaſt moſt of them; then it ſeems probable that their great Currents may turn the Current of that Sea Weſtward; and ſo make it diſcharge its Waters into the Ocean in Time of an Ebb, through the *Streights* of *Gibraltar*; if not in the Day-time, yet at leaſt in the Night, when Sailers care not to enter ſo narrow a Paſſage, and ſo may not be aware of it. A ſecond Thing is, that the burning Mountains of *Ætna*, and *Strombula*, being in the midſt of that Sea, it is probable that the Waters in the Bottom of it may come very near the Sides of theſe Vulcanoes; which Sides being always exceeding hot, muſt needs dry up, waſte, and conſume ſuch large Quantities of its Waters, as may help to keep that Sea from over-flowing, though it has no Out-let. But then there is a third Thing, which ſeems to me moſt probable of any, which is, that there is ſome one or more ſubterraneous Paſſages between the *Mediterranean Sea* and the *Red Sea*, through which ſubterraneous Paſſages the *Mediterranean Sea* diſcharges and ſends out the

Waters that come into it, into the *Red Sea*; by which they are conveyed into the *Indian* Ocean: And ſince none of theſe three Things ſeems to be wholly improbable, all of them put together, may be allow'd to be a tolerably good Reaſon, why the *Mediterranean Sea* does not overflow, notwithſtanding the great Quantities of Waters that run daily into it.

But then as to the *Caſpian Sea*, which has four or five large Rivers running daily into it, and yet never over-flows, though it has no viſible Out-let; ſince the Waters raiſed by the Sun and Winds cannot be ſufficient to hinder it from over-flowing, becauſe they almoſt all return again, there is nothing to hinder it that I can think of at preſent, but only this, *viz.* that there muſt be ſome ſubterraneous Paſſages near the Sides or Bottom of that Sea, through which the Waters that come into it, do run out again, and that keeps it from over-flowing: And ſince there are mountainous Places to the Weſtward of it in *Armenia*, and likewiſe to the South-Eaſt of it in and about *Candabar*; and ſince there be many Paſſages for Waters to run in under the Bottoms of ſuch mountainous Places, I am apt to think that ſome Part of the Waters of the *Caſpiau Sea* do find a Paſſage to themſelves under ſome Part of *Armenia*, and then break out and make one of the Heads of the River *Euphrates*; and that other Part of them find a Paſſage towards *Candabar*, and ſoon after break out, and become one or more of the Heads of the River *Indus*. I have before endeavoured to make it appear, that there are and muſt be ſubterraneous Paſſages, through which the Waters of the Sea do run out into moſt Places of the Earth, and are the Origin of Fountains. And for further Confirmation of what is there ſaid, there is a River in *England* which I have ſeen, the Name of which I cannot well remember, unleſs in be the *Voollies*; it riſes in ſeveral ſmall Streams near *Horſham* in *Suſſex*, and theſe Streams run by the Side of St. *Leonard*'s Forreſt, and meet at the Pariſh of *Iſield* in *Surry*, where they become a River; and this River through a pretty deep but not very broad Channel, and by ſeveral Windings and Turnings, runs through the Pariſhes of *Iſield*, *Charlewood*, and *Harley*, and then turns Northward, and paſſes by *Rygate* half a Mile to the Southward of it, and ſoon after runs under the Downs of *Surry*; and I could never meet with any Man that could tell where it run out again; and though this River is often flooded and over-flows all its Banks, yet all the Waters of it ſtill run in under the ſaid Downs; and therefore it muſt have a ſubterraneous Paſſage of 15 or 20 Miles, if it runs Northward until it come to the *Thames*, or of 60 or 70 Miles, if it runs Eaſtward unto the Sea. And ſince there is ſuch a ſubterraneous Paſſage for Water ſo near Home, of which all the People of *England* may be fully ſatisfied if they pleaſe, I can ſee no Reaſon to doubt, that in many other Places of the World, there are many ſuch Paſſages for Water under Ground, ſome larger, ſome leſſer; eſpecially conſidering, that no tolerable Account can be given of many of the Phænomena relating to the Waters, unleſs they find Paſſages to themſelves under Ground. And ſince we are thus deeply engaged in the Waters, I hope it will not be counted an unpardonable Digreſſion, to take a ſhort View of *Noah*'s Flood, which was the greateſt Concourſe of Waters that ever was, or ever ſhall be.

Concerning Noah'*s Flood.*

HERE I have met with two or three Schemes, deſigned to ſhew, that ſuch a Deluge was both poſſible and practicable;

but methinks theſe Schemes were more laborious and operoſe, by a great deal, than they needed to have been; for if but three or four Things be granted, either of which cannot well be denied, it ſeems to me, that a ſatisfactory Account may be given of this univerſal Flood: But then, it is firſt to be obſerved, that they were only the Waters of the preſent Seas, that were employed for this Purpoſe, as appears from *Pſalm* civ. 6 and 9 *Ver.* where the *Pſalmiſt* ſays to God, *Thou coveredſt it*, i. e. *the Earth, with the Deep, as with a Garment, the Waters ſtood above the Mountains. Thou haſt ſet a Bound that they may not paſs over, that they turn not* again *to cover the Earth.* Now ſeeing the preſent Earth, and the preſent Seas are here ſpoken of, theſe Words ſhew plainly enough, that they were the Waters of the preſent Seas, which covered the Earth in the Time of the Deluge, and that God hinders them from doing ſo *again*, which plainly ſhows that they had covered the Earth once before the *Pſalmiſt*'s Days, and would have been apt to have done ſo again, if God did not hinder them.

This being premiſed, I deſire Leave to ſuppoſe, in the Iſt Place, that ſince the Seas are not all of a like Depth, the middle Depth of the Ocean is 4000 Cubits, or 1000 Fathoms: This cannot well be denied, becauſe no Man knows the true Depth of the Sea, ſo that it may be more than I ſuppoſe, for ought any one knows.

II^{dly}. I ſuppoſe, that the higheſt Hills or Mountains, that were before the Flood, did not exceed 333 Fathoms in perpendicular Height, that is, about 2664 Feet, which is a very great perpendicular Height; and how they are higher now, ſhall be ſhown anon.

III^{dly}. I ſuppoſe, that of all the whole Surface of the wholeGlobe of Seas and Land, only one third Part is dry Land, and all the other two third Parts are covered with Waters: This is evident from the bare Inſpection of Globes and Maps; neither is it ſaid any where, that the dry Land was leſſened by the Flood, but ſeems to be the ſame as to its Breadth and Length that it was before the Flood.

IV^{thly}. I ſuppoſe, that there is a thick, ſtrong Cruſt, made of glutinous and viſcous Matter, at the Bottom of all Seas; becauſe, without ſuch a Cruſt, the Waters would naturally ſink into the Earth, as we ſee in Pools of Water, which would ſoon ſink into the Earth, if they were not recruited by Rains: I ſay, without ſuch a

Cruſt, the Waters of the Seas would naturally ſink into the Earth, and run down towards its Center, ſo that no Seas could be ſeen on the Face of the Earth long before this Time; and that God by his Power, did pull up all this Bottom-Cruſt of all Seas, until it was as high as the Surface of the dry Land; this I take to be the Meaning of that *Hebrew* Phraſe in *Gen.* vii. 11. *All the Fountains of the Abyſs, or the great Deep, were broken up, or pulled up*; and that when God had thus pulled up the Bottom-Cruſt of all Seas, he, by ſeveral Paſſages, did let in the Air under the Cruſt, to fill the vacant Space, and to bear up the Cruſt: And thus the Deluge was in a great Meaſure brought to paſs; for the Waters of the Seas being all brought up with their Bottom-Cruſt, were all above the Surface of the Globe, and having nothing to hinder them, muſt naturally run round the Globe to preſerve an Equilibrium; and being a thouſand Fathoms in Deepneſs, one third Part of them, *viz.* 333 Fathoms, would cover the dry Land, which is but a third Part of the Surface of the Globe, and the other two third Parts would cover the Bottom-Cruſt of the Seas, and ſo all the Globe be covered with 333 Fathoms of

Water, which would cover the Tops of the higheſt Mountains then on Earth: And nothing of all this ſeems any-wiſe incredible, it being no more to Almighty God, to pull up the Bottom-Cruſt of all Seas with their Waters on Top of it, and to let in the Air under the Cruſt, than it is to a Man, to pull a Cork out of a Bottle, and pour the Liquor out: But then it is ſaid, *Gen.* vii. 20. that when the Mountains were covered, the Waters did prevail yet 15 Cubits upward; and there were two or three Things that contributed to this Riſing of the Waters; the firſt and chief of which, was a moſt heavy Rain, which continued for no leſs Time, than the Space of forty Days and forty Nights; and this ſo heavy, ſo conſtant, and ſo long laſting a Rain, coming down from the Heavens, ſeems to be the true Meaning of that *Hebrew* Phraſe, *Gen.* vii. 11, 12. *viz.* that the Windows, or Flood-Gates, of Heaven were opened; ſo much Water therefore came down by this ſo exceeding great Rain, as could not chuſe but to raiſe the Flood for at leaſt one ten Cubits of the fifteen. Another Thing that raiſed the Waters, was the greateſt Part of the Air being under the Bottom-Cruſt of the Seas, ſo that the Air could make little or no Impreſſion on the Face of the Waters, as it always uſed to do; and ſo the Waters being freed from the great Weight and Burden of the Air, muſt needs riſe and ſwell three or four Cubits higher. A third Thing that raiſed the Waters, was the Bulk of the Hills, which were then as numerous, though not ſo great, as now; for the Bulk of the Hills muſt take up ſo much Room, as that far leſs Water would ſerve to cover the dry Land, than if it had been all plain and level, without any Hill or Mountain; and ſo the Waters ſaved by the Bulk of ſo many Hills and Mountains, muſt be ſufficient to raiſe the Waters a Cubit or two higher. And thus the Flood was brought to its greateſt Height, *viz.* 15 Cubits upwards, after all the Mountains were covered; and in this Height the Flood remained, for the Space of 150 Days, or five Months: And in all that Time the Mountains and Hills were becoming bigger and larger; for the Earth ſtill keeping its uſual Motion, round its own Axis from Weſt to Eaſt, could not chuſe but to make the Waters, which lay upon its Surface, to run round in a Motion ſuitable to its own Motion; and then the great Strength of ſo deep Waters would bear and lift up almoſt all Things on the Face of the dry Land, that were not fixed to it; ſuch as the Bodies of all Mankind without the Ark, and alſo of all Beaſts, and all Sorts of Cattle, Trees, and Beams of Timber, and all wooden Works, Boats loaded with great Stones, and great Beams of Timber, and Waggons and other Land Carriages loaded in like Manner, with Roofs of Houſes, Mud and Dirt, and all Sorts of Rubbiſh. The Motion of the Waters would bring all theſe, and many other Things, floating along with them; and ſo when ſeveral heavy Things happened to come above the Top of any of the higheſt Mountains, the Waters being there too ſhallow to bear them up, they would ſink and ſtay there; and ſo in like Manner other Floats coming along, would alſo ſink and ſtay there, and ſo ſtill raiſe the Mountains higher: And ſometimes theſe mighty Waters would lift up, and carry away almoſt whole Houſes of three or four Stories Height, and perhaps more, and ſo carry them along, till they came to the Top of ſome Mountains, and there let them ſink and remain, by which an Hill, ſuch as *Teneriff*, might be raiſed between 20 and 30 Feet at once: And ſo by theſe Means the Mountains could not miſs being raiſed as high as the Surface of the Waters, that is, 15 Cubits higher than they were before; and accordingly *Noah*'s Ark, which had floated about for five Months, coming to one of the Mountains now raiſed as high as the Surface of the Waters, it reſted and ſtayed there, *Gen.* viii. 4. And the Mountains being thus raiſed to the perpendicular Height of above 336 Fathoms, I ſhall not believe, that any Mountain can now be found of a larger perpendicular Height, above the Vallies or Water where it ſtands, unleſs I be aſſured of the contrary by an exactly-performed Experiment: Nor do I think that any Mountain, at preſent, is ſo high; becauſe, in the Space of 4086 Years, that are paſſed ſince the Flood, there is no Doubt but that the Rains and Snow have waſhed down ſome of the Tops of Mountains and Hills, except where they are covered with great Stones and Rocks: And as the Mountains were thus raiſed in Height by the Flood, ſo were they alſo enlarged in Breadth and Length; for as the Waters began to decreaſe, ſuch heavy Things as came floating along with the eaſterly Current of the Waters, would ſtay and ſtick to the Eaſt Sides of the Hills and Mountains, and alſo turn in to the Weſt Sides with the

Waters running round and next to the ſaid Mountains; and this was the Cauſe why Hills and Mountains are longeſt, and ſtand in Ridges, from Eaſt to Weſt, as it may be ſeen at this Day; and as the Waters decreaſed ſtill more, the lower Hills and riſing Grounds would be increaſed and raiſed higher, by heavy Things ſinking down and ſticking to them, and to the Bottoms of Mountains. Thus it appears to have been a Thing unavoidable, that the Hills and Mountains ſhould be raiſed in Height, and enlarged in Length and Breadth, by *Noah*'s Flood: And thus alſo the Waters, and the Mountains, being raiſed to their full Height, in the Space of five Months, it pleaſed God, in Compaſſion to *Noah* and his Family, and the living Creatures that were with him in the Ark, to make the Waters then begin to abate, by making a Wind paſs over the Earth, *Gen.* viii. 1. And this I ſuppoſe he did, by letting the Air out at one or two Places, which had been incloſed all this while, under the Bottom-Cruſt of the Seas; for the Air being preſſed into a Blaſt of Wind, will force its Way upwards, through any Depth of a fine Liquid, ſuch as Waters be; and ſo as the Air went out by little and little, the Bottom-Cruſt of the Seas, with the Waters upon it, began to ſink down into their former Station, by little and little, and thus they continued to proceed for the Space of three Months, before the new-made Tops of Mountains could be ſeen above the Waters, *Gen.* viii. 5. and ſo in about one Month more, the Air being all gone out, the Bottom-Cruſt of the Sea was ſettled down into its own Place, and then the Surface of the Sea was the loweſt on the Face of the Globe; and therefore the Waters on the formerly dry Land, finding a Deſcent towards the Seas, did naturally run thither through all the Deſcents they could meet with, and continued running off towards the Sea for another Month, and then all the Waters were gotten into the Seas again, and left the dry Land all covered over with Mud, Dirt and Rubbiſh, ſo that no Place of it could be known again by ſuch as had ſeen it formerly; but all that wicked Generation, and all their Works, were quite deſtroyed: And thus *Noah*'s Flood was ten Months on the Earth, *Gen.* viii. 13. five Months in its Height, and five Months more to its End; and then the Air being all at Liberty, the Winds began to blow, and theſe, with the Sun's Heat and Shining, began to dry up the Moiſture on the Face of the Land, and make Herbs and Graſs to grow; and the Seas being returned to their own Places, the Fountains and Rivers began to run as formerly they had done, ſo that in about two more Months, the dry Land was become habitable both for Man and Beaſt, and ſo God commanded *Noah* to go out of the Ark, with all that were with him in it, *Gen.* viii. 14, 15. And now, I know not how the learned and judicious Readers will approve of this Account of *Noah*'s Flood; but it ſeems to be natural, eaſy, and rational, and every Thing in it ſufficiently accounted for, and yet nothing forced againſt its uſual Courſe, or natural Tendency, and only two or three Things in it miraculous, to ſhow that Almighty God was the Author and firſt Cauſe of it. But now that we have been dabbling ſo long among the Waters, we ſeem to ſtand in need of ſome *Winds* to dry us again; and accordingly, let us beſtow ſome Thoughts upon the Winds, ſince they alſo are one of the Phænomena, and that too a very uſeful one.

PATENT OFFICE LIBRARY

Of the TRADE-WINDS.

I Said before, that the Motion of the Earth round its own Axis, does ſerve for two or three Uſes; and having treated of two of them, a third Uſe of the Earth's Motion round its own Axis is this, *viz.* it is the firſt and chief Cauſe of the Trade-Winds; for the upper Part of the Earth between the two Tropicks, as it turns from Weſt to Eaſt, does preſs and puſh forwards the Air that is juſt before it; and then the Air, to preſerve its Equilibrium, flies back immediately, on each Side of that upper Part of the Earth, and ſo meets at the Middle of it; for as we may ſee a Ship under Sail, when her Bows preſs the Water before them, the liquid Water runs back on each Side of the Ship, and meets at her Stern; even ſo the Air being a fine Fluid, and being preſſed by the Motion of the upper Part of the Earth, as it turns round its Axis, flies back on each Side, and meets at the Middle; and ſo the Earth keeping a conſtant Motion, makes the Air ſtill to fly back in the foreſaid Manner, which makes a conſtant gentle Gale of Wind flying Weſtward, and bending towards the Middle Line of the Earth; but then, the Moon's monthly Motion being ſwift and rapid, and preſſing a great Body of the Air before it, and being from Eaſt to Weſt, which agrees in the main with the Motion of the foreſaid gentle Wind, this Motion of the Air by the Moon's Motion, adds to, and ſtrengthens, the foreſaid gentle Gale of Wind, and makes it a good Gale that fills the Sails of Ships, and makes them ſail a good Pace; and ſo this Wind, begun and continued by the Motion of the Earth, and aſſiſted by the Motion of the Moon, blows conſtantly one Way, unleſs it be interrupted by ſome ſtronger Wind, or Hurricane, and ſo is very uſeful to Sailers, who call it the Trade-Wind.

Of the MONSOONS.

THESE Monſoons are nothing but Trade-Winds, which would always fly and blow as other Trade-Winds do, if they were not hindered and forced backward by the great Breadth and Height of the Promontory of *Africa*, which reaches from the Tropick of *Cancer*, to the *Cape of Good-Hope*; and when the Monſoons are interrupted, and forced backward by the ſaid Promontory, they then in ſtruggling to keep the Trade-Winds Courſe, do often make various and turbulent Winds, and ſome Sort of Hurricanes, which Sailers call the breaking up of the Monſoons; but they being no ways able to get over the ſaid Promontory, and yet keep ſtill in Motion by the Earth's conſtant Motion, they ſeem in ſome Meaſure to join with the Earth's Motion, and ſo take their Courſe directly contrary to that of the Trade-Winds, and ſo fly and blow Eaſtward, bending from the Middle-Line, according as they find Sea-Room, and leaſt Interruption from Land or Shores; and thus they continue flying backwards for about the Space of ſix Months, until the Moon, the Trade-Winds Friend, comes to their Aſſiſtance; and then they again make various Winds, until by Help of the Moon's weſterly Motion, they get over the *African* Promontory; and then they fly Weſtward, bending towards the Middle Line, and ſo keep the uſual Courſe of the Trade-Winds, all the while they have the Moon's Aſſiſtance, which is about ſix Months: And the Reaſon why they have not the Moon's Aſſiſtance always, is partly by Reaſon of the Moon's annual Motion round the Eclip̣tick; and partly becauſe the Monſoons keep certain Tracts and Paths, ſome to the Southward of the Middle Line, and ſome to the Northward of it, and ſo the Moon cannot aſſiſt them, until ſhe come to be on that Side of the Middle Line, where their uſual Paths and Tracts are. Now, there are but few Monſoons to the Southward of the Middle Line, by Reaſon the Promontory of *Africa* is ſo narrow near the *Cape of Good-Hope*, as that the Trade-Winds do eaſily get over it, and ſo keep their uſual Courſe throughout the Year; only near the Middle Line where the ſaid Promontory is broad, between *Zangubar* and *Sumatra*, there are ſome Monſoons, and the Moon aſſiſts them to take the uſual Courſe of the Trade-Winds, from the Time that ſhe comes near the Tropick of *Cancer*, until ſhe comes near the Tropick of *Capricorn*, i. e. from the Beginning of *June*, unto the Beginning of *December*: And then as to the many Monſoons that are to the Northward of the Middle Line, near the Coaſt of *China*, and up toward *Bombay*, the Moon cauſes them to take the uſual Courſe of the Trade-Winds, from ſuch Time as ſhe has paſſed through the Sign *Libra*, until ſhe has paſſed through the

Sign *Aries*, i. e. from the Beginning of *October*, until the Beginning of *April*: This is the uſual Time that the Monſoons blow Weſtward; but the Time is not certain, becauſe of the breaking up of the Monſoons, which takes up ſome Time at leaſt twice every Year.

From all which it ſeems plain enough, that it is the Promontory of *Africa*, that hinders the Monſoons from blowing always, as the other Trade-Winds do; for there are no Monſoons heard of, but only to the Eaſtward of that Promontory, and only where it is broad; and that it is the ſwift weſterly Motion of the Moon, that helps the Monſoons to take the Courſe of the Trade-Winds, and to keep it ſo long as her annual Motion does allow her to be near and over their uſual Tracts and Paths, to lend them her Help: And perhaps the Name of Monſoons may be derived from Moon-Signs, becauſe as the Moon paſſes through the Signs of the Ecliptick, ſhe helps the Monſoons to take their natural Courſe of the Trade-Winds. And this ſeems to be a good and ſufficient Account of the Trade-Winds, and of the Monſoons.

Of WINDS in general.

WIND is ſome Part of the Air in Motion, and this Motion is ſometimes gentle, ſometimes ſtrong, and ſometimes a violent Motion; and the Things that are moſt likely to put the Air in ſuch Motion, are, firſt, the Heat of the Sun, which rarifies and extends the Air, and makes it preſs upon the circumambient Air and diſturb it; and then the Air thus diſturbed, coming between the Earth and the Moon, then their ſwift and yet contrary Motions put the Air into ſome pretty great Motion; and then when ſome heavy Clouds of Water happen to preſs upon this moving Air, that encreaſes its Motion; and then if by ſuch heavy Clouds this Air happens to be pent in, on all Sides but one, then it flies out there with a violent Motion, and a ſtrong Blaſt: This ſeems to be a probable Account of the uſual Cauſe of the ordinary Winds; but then as to the great Variety of Winds, and the great Variety of the Courſes which they take, and the great Variety of their Strength and Force; theſe are ſo unaccountable Things, as that they ſeem to

me

me to have a ſupernatural Cauſe; as be alſo Sounds, which are conveyed to us by ſome Motion of the Air: But then it is certain, that the Winds are a great Preſervation of the Health of both Men and Beaſts; for there are ſo many rotten and unhealthful Steams, Vapours, Reeks, and Smells, ariſing daily from putrid Places and Things on the Face of the Earth, as that if theſe were not frequently driven away, and the Air cleanſed by the Winds, it is my humble Opinion, that neither Men nor Beaſts could live long upon the Face of the Earth; and that long Calms are dangerous, and often accompany Contagions; and beſides, Winds are ſo neceſſary for Trade and Traffick, as that there could be no keeping Commerce with foreign Nations without them; and they may be Means of Mercy, and alſo of Judgments; and accordingly it pleaſes God to take Care of them, ſo as to bring the Winds out of his Treaſures, *Pſalm* cxxxv. 7. and to make the ſtormy Wind fulfil his Word, *Pſalm* cxlviii. 8. And theſe are the few Things that ſeemed to ſtand in need of Amendment, in the preſent Accounts of the Syſtem, and ſome of the principal Phænomena of this viſible World; and, in my Endeavours to amend them, as alſo in my Endeavours to give ſome Aſſiſtance to the Sailers, for the better finding of their Longitude and Latitude at Sea, I hope I have advanced nothing unworthy of the Approbation of the learned and judicious Readers; but if any one thinks otherwiſe, I deſire not to impoſe my Opinion on any Perſon, but allow every one to approve of what he thinks beſt: Only if I deſire the Favour of my Readers, to take ſpecial Care, that neither Envy, nor the Bias of former Opinions, ſhall ever hinder them from approving of what is good, either on theſe, or any other Accounts, I hope it will be no Offence, but will rather ſerve for a friendly *Farewell*.

INDEX.

Concerning the Improvements in Navigation Page 1
How the Pedeſtal is to be made 5
How the Quadrant is to be made 7
Some general Rules to be obſerved in making Obſervation for Longitude 10
Particular Rules in making Obſervation for Longitude 11
How to find the Latitude at Sea, with the ſame Inſtruments that find the Longitude 18
General and particular Rules in making Obſervation for Latitude 19
A Poſtſcript 26
An Endeavour to make ſome Amendments in the preſent Accounts of the Syſtem, and the principal Phænomena of this viſible World 29
Of the Sun 30
Of the Moon 33
Of the Earth 38
Of the Tides 40
Of the true Cauſe of Fountains 45
Of the Mediterranean *and* Caſpian *Seas* 53
Of Noah's *Flood* 57
Of the Trade-Winds 68
Of the Monſoons 69
Of Winds in general 73

[illegible]*NIS.*

PATENT OFFICE LIBRARY.
BRITISH MUSEUM 18 70 MAR